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This annual report of progress provides a summary of work accomplished in support of the Office of Military Performance Assessment Technology. The objective of this effort is to integrate and verify man-machine modeling tools to provide a user with software to generate task decomposition structures that are transportable to sequential network models. A microSAINT model of the weapons system director's commit task was completed. Several technology transfers are discussed.

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Samuel G. Schiffett 12/31/92

Principal Investigator's Signature Date

FY 1992 ANNUAL REPORT
INTEGRATION AND VERIFICATION OF MAN-MACHINE MODELING TOOLS

INTRODUCTION

This annual report of progress provides a summary of work accomplished in support of the Office of Military Performance Assessment Technology (OMPAT). The objective of this effort is to integrate and verify man-machine modeling tools to provide a user (principal investigator) with an expanded capability to access widely accepted modeling methodology and to share common data bases with other investigators. Of primary importance in this project is establishing the utility of commercially available software to assist in the generation of task decomposition structures and the "seamless" translation of task describing functions into sequential networking modeling software. The end goal is to develop and validate a set of military relevant, operator performance risk criteria based on models and part task simulation data.

METHODS

A wide variety of off-the-shelf, commercially available software was assessed in the formative stages of this project. The methods used and results of those evaluations were attached to last year's Annual Report. The final recommendation for graphically based, task analytical software was IDEF and the choice of sequential task modeling software was SAINTplus. The predominant amount of time in FY92 was spent developing hierarchical task decompositions of graphically based representations of an AWACS weapons air controller commit task. The task was then translated from SAINTplus into a microSAINT format and verified using previously collected data from earlier simulation studies sponsored by OMPAT. The microSAINT models run on IBM 386 compatible hardware under DOS 3.0 or higher rather than the VAX version of SAINTplus.

RESULTS

An abrupt end to operation Desert Storm and a decrease in data analysis and reporting commitments diminished our involvement considerably with wartime crisis management. This allowed our staff to return to the efforts of this project in the first quarter of FY92 (Oct-Dec 1991). An on-site programmatic review of current and pending work was discussed in January 1992 with Dr. Fred Hegge, Dr. Tim Elsmore and LtCOL Dave Penetar to revise our schedule. A detailed plan of action was agreed upon

to renew efforts to reduce and analyze the AWACS data to develop individual measures and team performance measures. A total of seven outcome measures have been defined in a top-down approach from the generalized team performance measures. Software has been completed to extract individual variables of interest such as drug, day, workload, cognitive skills, and personality traits. The individual measures will also include a comparison of individual performance scores on the cognitive task battery.

A descriptive model for experienced, average, and naive weapon system directors based on performance outcome measures was tested with simulation data from a prior study conducted in 1990. The model of human activity was developed by a subject matter expert using SAINTplus a software product from Micro Analysis and Design, Inc. that runs on the VAX line of computers. The software development has since been discontinued and is distributed by a secondary vendor. The predictive results of the model were disappointing since a number of variables were not included which artificially constrained the decision making task i.e., anticipation and distraction. The model will be enhanced to include an updated version using microSAINT software instead of SAINTplus.

A major portion of the year was spent developing an integrated task analysis methodology system to identify and derive synthetic tasks that are representative of the critical decision making processes of weapon systems operators performing "real world" missions using high fidelity simulators. A reductive task analysis approach developed by Dr. Gerald Chubb, Ohio State University, was used to identify the essential cognitive components necessary to commit friendly forces against enemy forces in an air defense scenario. The basis of this technique applied by our subject matter experts was a study sponsored by the Air Force Office of Scientific Research to evaluate the reliability of using R.B. Miller's Task Strategies to formulate a part-task decomposition.

Technology Transfers

The functional part-task decomposition was completed in March 1992 from structured interviews of 14 AWACS weapon system operators that participated in Operation Desert Storm. These "wartime validated" task structures have greatly enhanced the operational value of our descriptive models. We were able to use these revised task structures to design a more effective and efficient display format for the AWACS Weapons Director's console for the E-3 AWACS aircraft. Dr. Gary Kline and his associates conducted a simulation study in the summer of 1992 in the Aircrew Evaluation Sustained Operations Performance (AESOP) facility at Brooks AFB, TX to evaluate situational awareness of Air Controllers using the new versus old displays. This was a direct technology transfer, to operational commands within the Air

Force, of an OMPAT product that will enhance the crewstation interface in the AWACS E-3 aircraft. The report is presently being prepared for final publication.

In 1992 NASA funded a secondary spin-off of OMPAT technology (microSAINT) to support Space Station Freedom's assembly tasks (tele-robotics grappling arm). The microSAINT model dynamically describes a satellite retrieval task verified from ground-based simulation training exercises at Johnson Space Center. It is planned that this model will be expanded to include human operator characteristics to predict the effects of microgravity on retrieving the Hubble telescope scheduled for December 1993. This work, in conjunction with future studies, will serve as the foundation for developing an integrated set of methodologies for the evaluation of human performance and behavior in extended duration spaceflight missions necessary to assemble Space Station Freedom.

CONCLUSIONS

Significant progress has been made in integrating and verifying man-machine modeling tools. A microSAINT model of the weapons system director's commit task was useful in evaluating task decomposition software. Several technology transfers were completed using software products from the Office of Military Performance Assessment Technology.

APPENDIX

Plans, Reports, and Presentations

PLANS

Since 1993 is the last year of the four year effort a final report will be prepared to summarize all experimental results and document all work completed from 1990 through 1993.

The final report on the comparative effects of antihistamines on individual performance measures of AWACS weapon directors will be completed and submitted for review in Spring of 1992. This is the last report in that series of studies conducted in 1990.

After Alpha software testing is completed for the Synthetic Task (SYNTAS) workstation under MIPR 90MM0502, formal Beta testing will begin. Several applications are planned for SYNTAS that will highlight the unique features of this new OMPAT product.

Near-term plans for late summer of 1993 include conducting a large scale continuous operations study using the SYNTAS workstation on the DARPA Distributed Simulation Internet. We will transfer SYNTAS technology to DOD Thrust 6 - Synthetic Environments for Modeling and Simulation. The long term plans for the SYNTAS workstation will be used to emulate critical job functions of military personnel that are subjected to radiation exposure (anti-emetic drug development) during nuclear attack.

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Dalrymple, M.A. (November 1991). Evaluating Airborne Warning and Control System Strategy and Tactics as They Relate to Simulated Mission Events. AL-TP-1991-0049, Armstrong Laboratory, Brooks AFB, TX.

Eddy, D.R., Dalrymple, M.A. & Schiflett, S.G. (June 1992). Comparative Effects of Antihistamines on Aircrew Mission Effectiveness under Sustained Operations. AL-TR-1992-0018, Armstrong Laboratory, Brooks AFB, TX.

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Adam, S. & Diaz, M. Task Network Models of Performance in Microgravity. NASA TM-104747, Johnson Space Center, Houston, TX, April 1992.

PRESENTATIONS

Eddy, D.R. Performance Assessment of Complex Team Tasks in Tactical Training Environments. Human Factors Society Convention, in San Francisco, Calif., Sept 1991.

Briefings to Distinguished Visitors:

DOD

Dr. Monetta, Director of Research & Advanced Technology DDR&E
Dr. Bachkosky, Deputy Director, DDR&E
RAdm Kollmorgan, DARPA/SIMNET
Dr. Neyland, Director WARBREAKER
Dr. Young, HDQ DNA/RARP

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